

### **REMARKS**

By this Amendment, Applicants have placed section headings in the application removing the bold type as requested by the Examiner. On page 4 of the application, equations 1 and 2 were inadvertently printed inconsistently with the text. Applicants have corrected the order of equations 1 and 2 to make it consistent with the text. These amendments to the specification correct minor typographical errors and do not introduce new matter. Claim 1 has been amended to include that after calculating a transformation, which registers two images with each other, a measure of the local confidence in that registration is then calculated and this measure of the local confidence in the registration is then displayed. Support for the amendments to claim 1 can be found in the specification, for example, at pages 2, and 4-6. Applicants have amended claim 14 to depend from claim 9. Applicants have also amended claims 18 and 19 to recite that the computer program or computer program product is stored on a computer-readable storage medium. Support for the amendments to claims 18 and 19 can be found in the specification, for example, at page 3, lines 22-25 and claims 18 and 19. No new matter has been added. Applicants respectfully request entry of the amendment and allowance of the pending claims.

### **Rejection under 35 U.S.C. §112, Second Paragraph**

The Examiner rejected claim 14 as allegedly lacking antecedent basis for the phrase “visually distinguishable overlay”. Applicants have amended claim 14 to depend from claim 9 as suggested by the Examiner. Thus, Applicants submit that this rejection is now moot.

### **Rejection Under 35 U.S.C. § 101**

Claims 18 and 19 are rejected under 35 U.S.C. §101 as allegedly directed to non-statutory subject matter. Applicants respectfully traverse this rejection.

The Examiner has the initial burden of showing that the claims are not directed to statutory subject matter. Applicants respectfully submit that the Examiner has not met

the burden. Nevertheless, Applicants have amended claims 18 and 19 to specifically recite that the computer program or computer program product is stored on a computer-readable storage medium. Thus, claims 18 and 19 are directed to one or more “tangible physical article(s)” as described in MPEP 2106 and fully comply with 35 U.S.C. § 101. Applicants respectfully request withdrawal of this rejection.

**Rejection Under 35 U.S.C. §103(a)**

Claims 1, 7-11, 13, and 17-20 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Avinash (2004/0017935) in view of Novak (2002/0028006). Claims 2-4 and 6 are rejected as allegedly being unpatentable over Avinash in view of Novak and Shi (“Volumetric deformation analysis using mechanics-based data fusion: applications in cardiac motion recovery”). Claim 5 is rejected as allegedly being unpatentable over Avinash in view of Novak, Shi, and O’Donnell (“Strain magnitude estimation based on adaptive incompressibility processing”). Claim 12 is rejected as allegedly being unpatentable over Avinash in view of Novak and Ditt (US Patent No. 7,110,616). Claims 14-16 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Avinash in view of Novak and Hsu (U.S. Patent No. 6,016,442). Applicants respectfully disagree.

To establish a *prima facie* case of obviousness the Examiner has the burden of establishing that the teachings of more than one reference may be considered in combination provided one of ordinary skill in the art would combine the references in that way to solve the problem facing the inventor. *KSR International Co. v. Teleflex Inc.* 127 S. Ct. 1727, 1734 (April 30, 2007). Applicants respectfully submit that the Examiner has not met that burden.

Claim 1 has been amended to include that after calculating a transformation, which registers two images with each other, a measure of the local confidence in that registration is then calculated and this measure of the local confidence in the registration is then displayed. Applicants respectfully submit that some of the prior art cited do have a calculation of some confidence level but it is not the confidence in the registration of

two images. Accordingly, none of the cited prior art references disclose the step of calculating a measure of the local confidence in the registration. Further, none of the cited prior art references disclose displaying such a measure of local confidence in the registration. Therefore one of ordinary skill in the art upon combining the cited references still does not obtain the currently claimed invention and the claims cannot be considered obvious.

Avinash discloses a system of registration of images, using a prior segmentation step to define regions of interest, the registration step, and then a comparison step. The purpose of the comparison step is to assess how the image has changed. This comparison is done by comparing the intensities of the original target and the registered source image, either by subtraction or by a more complex method, they call “adaptive comparison”. However the comparison is still based on the intensities within the images, and the purpose is to aid the comparison that would normally be performed after registration. This comparison is to see what the changes are between the target and source images. Thus, as the Examiner has correctly pointed out, Avinash, among other things, does not disclose displaying a measure of confidence.

With regard to Novak, this reference discloses a method for automatically detecting nodules in lungs and then displaying them in such a way to be useful to clinicians, using a Graphical User Interface (GUI). The GUI allows the data to be viewed along with the segmented regions of interest, and then the parameters of the segmentation can be altered and viewed at the same time. A confidence level is included which is a single percentage value, indicating the likelihood that the segmented region is in fact a lung nodule. This confidence is based on various parameters associated with the segmented region, for example the volume, diameter, sphericity, *etc.* The GUI allows these segmented regions to be helpfully visualized. Thus the confidence measure, which is calculated and displayed by Novak is the confidence in whether a segmented structure is in fact a lung nodule. This is because Novak is concerned with identifying and classifying nodules vs. non-nodules in the image. This is clear from page 3, paragraph [0036] that says at the end that “*in general, the idea is to identify and classify nodules vs. non-nodules*”.

Thus the confidence value calculated in Novak is based on anatomical knowledge of the structure of lung nodules and the confidence measure is an indication of the likelihood that the object of interest corresponds to a nodule. This is clear from page 3, paragraph [0039] of Novak, which says:

*...once the candidate object has been segmented, properties of the candidate object are measured. These measurements include, for example, the object's centroid, diameter, volume, circularity, sphericity, and average intensity, as shown in the pop-up window of Fig. 6. Anatomical knowledge is used to reason about the likelihood that the object of interest corresponds to a nodule. The CAD system 100 computes the confidence measure indicating that the CAD system's estimate of the likelihood that the object is a nodule.*

Paragraphs [0055] and [0056] of Novak emphasize that it is this confidence level which is then displayed to the user. Thus the confidence calculated in Novak is a single value in each object of interest, which expresses how likely it is that the object of interest is a lung nodule. This bears no relation to the confidence in the registration of two images, which is calculated as currently claimed in claim 1. The confidence in the registration is an indication of how likely it is that the registration of the two images with each other is correct. This is clearly different from an anatomical likelihood that some object in an image is a specific type of structure of interest. Consequently Novak does not add to Avinash the features specified in amended claim 1 of calculating a confidence in the registration of the two images or of displaying such a confidence in the registration of the two images. Applicants respectfully submit that claim 1 as amended is not rendered obvious by Avinash in view of Novak.

With regard to the rejection of claims 2-4 and 6 over a combination of Avinash, Novak and Shi, as discussed above, Avinash and Novak do not disclose calculating a confidence in the registration of the two images or of displaying such a confidence in the registration of the two images. Shi does not rectify this defect. Shi introduces a method of analyzing deformations of the cardiac wall, and incorporates constraints with physical meaning into the ill-posed problem. Shi looks at the information that can be derived from

the images, such as surface, shape, motion *etc.*, and then discloses a registration framework that includes a model of the myocardium. While describing motion, confidence measures are mentioned, but these are based on bending energy. That is, the correctly registered point is likely to have a minimum bending energy. This measure ensures a smooth deformation field. Again this is used within the registration, as opposed to analyzing the confidence in the registration after it has been performed. This is clear by referring to the right column of page 93 of Shi, which explains at equation 6 how the confidence measure is calculated. This confidence measure  $C(x)$  is then used in equation 7 to constrain the registration process itself. Thus this confidence measure based on minimizing binding energy is one of the factors being used in deciding the transformation, which registers two images. It is not being used afterwards as a measure of the confidence in the overall registration (*i.e.*, how likely the registration is to be correct). Further, there is no disclosure of displaying a confidence measure in the registration of the two images.

With regard to the rejection of claim 5 in view of a combination of Avinash, Novak and Shi with O'Donnell, as discussed above, Avinash, Novak and Shi do not disclose calculating a confidence in the registration of the two images or of displaying such a confidence in the registration of the two images. O'Donnell does not rectify this defect. O'Donnell presents a method of producing shear strain and strain magnitude images for cardiac deformations. This is a difficult problem due to high Signal-to-Noise Ratio (SNR). They realized that displacement errors they were finding and high spatial gradients in their correlation coefficient between images were strongly related and as such introduced a confidence measure in their displacement errors. This produced a weighting term that could then be used in the reconstruction of the strain images. It is clear from page 1645, right column, middle paragraph of O'Donnell that the confidence weight is just included as a weighting term in the reconstruction procedure rather than being displayed as a confidence level in a registration of two images. O'Donnell states:

*the confidence weight is then included as an additional weighting term in the incompressibility reconstruction procedure described in [10]*

This confidence is in something totally different to the registration of the current claims, and is used within the method to reconstruct a new type of image, not to measure the confidence of that image. Thus, again, O'Donnell does not calculate a confidence in a registration result, nor is a confidence calculated from a magnitude of local deformation in the transformation.

With regard to the rejection of claim 12 over Avinash, Novak and Ditt, as discussed above, Avinash, and Novak do not disclose calculating a confidence in the registration of the two images or of displaying such a confidence in the registration of the two images. Ditt does not rectify this defect. Ditt discloses a method of registration in which the user views the image histograms prior to the registration and can select grey-level values for the images to be registered. However, contrary to claim 12, this does not correspond to varying the grey level of a visually distinguishable overlay in dependence of a confidence measure in the registration.

With regard to the rejection of claims 14-16 in view of Avinash, Novak and Hsu, as discussed above, Avinash and Novak do not disclose calculating a confidence in the registration of the two images or of displaying such a confidence in the registration of the two images. Hsu does not rectify this defect. Hsu discloses a method for displaying cardiac arrhythmia data in such a way that it can be clinically useful. This is not related to the confidence measure in the registration as recited in claims 14-16.

In summary, none of the cited prior art references disclose the step of calculating a measure of the local confidence in the registration. Further, none of the cited prior art references disclose displaying such a measure of local confidence in the registration. Therefore one of ordinary skill in the art upon combining the cited references still does not obtain the currently claimed invention. Accordingly, the claims cannot be considered obvious and Applicants respectfully request withdrawal of the rejections.

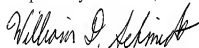
**Conclusion**

Reconsideration and allowance are respectfully solicited.

Enclosed is the fee for a two-month extension of time. No additional fee is believed to be due with respect to filing this amendment. If any additional fees are due, or an overpayment has been made, please charge, or credit, our Deposit Account No. 11-0171 for such sum.

If the Examiner has any questions regarding the present application, the Examiner is cordially invited to contact Applicant's attorney at the telephone number provided below.

Respectfully submitted,



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William D. Schmidt  
Registration No.: 39,492  
Attorney for Applicant

Kalow & Springut LLP  
Telephone No.: (212) 813-1600